

(a) a triangulation technique to determine, for each of three or more of the base stations, one of: a distance and a wireless signal angle of arrival between the mobile station and the base station using the wireless signal measurements;

(b) a learning technique, wherein said learning technique determines an association for associating:

(i) the wireless signal measurements, and

(ii) data indicative of a location for the mobile station,

wherein said association is determined by a training process using a plurality of data pairs, each said pair including: first information indicative of a location of some mobile station, and second information from wireless signal measurements between said some mobile station and one or more of the base stations when said some mobile station is at the location;

(c) a stochastic technique, wherein each said stochastic technique uses a statistical correlation for correlating:

(i) the wireless signal measurements, and

(ii) data indicative of a location for the mobile station,

wherein said correlation is used for determining a probability that the mobile station is within an area, and

(B) for at least a particular one of said techniques performed by said first location estimator, said second location estimator does not perform said particular technique when supplied with said wireless signal measurements;

first supplying said first location estimator with first data obtained from the wireless signal measurements;

first generating, by said first location estimator, first location related information having at least a first estimate for the mobile station's location;

second supplying said second location estimator with second data obtained from the wireless signal measurements;

second generating, by said second location estimator, second location related information having at least a second estimate for the mobile station's location;

determining a resulting location estimate of the mobile station [using] that is dependent upon:

(a) a first value obtained from said first location related information, and (b) a second value obtained from said second location related information

6. (Once Amended) A method as claimed in Claim 1, further including a step of retrieving at least one of (a1) and (b1) following:

(a1) first historical location data having: (i) a first set of historical location estimates generated by said first location estimator for wireless signal measurements obtained from transmissions between one or more mobile stations, at a first plurality of locations, and said plurality of base stations[at a first plurality of locations], wherein a distance between at least one of said location estimates of said first set, and said first estimate of said mobile station's location is determined to be less than a first predetermined value, and (ii) data identifying said locations of said first plurality of locations;

(b1) second historical location data having: (i) a second set of historical location estimates generated by said second location estimator for wireless signal measurements obtained from transmissions between one or more mobile stations, at a second plurality of locations, and said plurality of base stations[at a second plurality of locations], wherein a distance between at least one of said location estimates of said second set, said second estimate of said mobile station's location is determined to be less than a second predetermined value, and (ii) data identifying said locations of said second plurality of locations.

A2
cont

7. (Once Amended) A method as claimed in Claim 1, further including, for at least one location estimate of said first and second estimates, a step of obtaining one of a likelihood value and a probability that a location of said mobile station is in said one location estimate, wherein said likelihood value is obtained using historical location estimates generated by the location estimator that generated said one location estimate [when the location estimator is supplied with wireless signal measurements obtained from transmissions between one or more mobile stations and said plurality of base stations at a plurality of locations].

A3
cont

14. (Once Amended) A method as claimed in Claim 1, wherein said first location estimator includes an artificial neural network, wherein said artificial neural network is one of: a multilayer perceptron, an adaptive resonance theory model, and a radial basis function network.

15. (Once Amended) A method as claimed in Claim 1, wherein said step of determining includes deriving a likelihood measurement that said mobile station is in said resulting

Q3
cont
location estimate, wherein said likelihood measurement is dependent upon at least one of: a first likelihood measurement that said mobile station is in said first estimate, and a second likelihood measurement that said mobile station is in said second estimate.

17. (Once Amended) A location system for locating a mobile station, wherein said mobile station is one of a plurality of mobile stations, and [wireless] signal measurements are capable of being obtained from wireless transmissions between the plurality of mobile stations and a plurality of base stations, the improvement characterized by:

Q4
cont
one or more location estimators, each said location estimator for estimating a location for each of one or more individual mobile stations of the plurality of mobile stations, when said location estimator is supplied with data obtained from a set of said wireless signal measurements [obtained from] corresponding to wireless transmissions between the individual mobile station and at least one of said plurality of base stations;

an archive for storing a plurality of data item collections, wherein for each geographical location of a plurality of geographical locations, there is one of said data item collections having (a1) and (a2) following:

(a1) a representation of the geographical location, and

(a2) wireless signal measurements corresponding to one of the plurality of mobile stations transmitting from approximately the geographical location of (a1);

a performance [estimator] evaluator for determining, for [each] at least one of said location estimators, a corresponding one or more performance measurements indicative of a previous performance of said one location estimator in locating one or more of the plurality of mobile stations,

wherein said corresponding performance measurements are determined using [location estimates generated by said one location estimator when said set of (a2), for some of] said data item collections[, is supplied to said one location estimator];

a controller for activating a group of at least one of said location estimators for generating corresponding location estimates of said mobile station when a first said set of wireless signal measurements [is obtained from] corresponding to wireless transmissions between said mobile station and said plurality of base stations is obtained, wherein one or more location hypotheses are generated, each said location hypothesis having:

- At
Coul.
- (b1) an hypothesized location estimate of said mobile station obtained using the corresponding location estimate generated by a location estimator of said group,
 - (b2) a likelihood value indicating a likelihood of said mobile station being at a location represented by said hypothesized location estimate of (b1), wherein said one or more corresponding performance measurements for said location estimator providing the location estimate of (b1) are used in determining said likelihood value;

a location estimator for determining a resulting location estimate of said mobile station, said resulting location estimate being derived using said hypothesized location estimates and said likelihood values from said one or more location hypotheses.

18. (Once Amended) A method as claimed in Claim 17, further including a step of transmitting said resulting location estimate to an emergency response center during a wireless communication with said mobile station [wherein said first set of wireless signal measurements is obtained].

20. (Once Amended) A method for locating a mobile station, wherein said mobile station is one of a plurality of mobile stations, and [wireless] signal measurements are capable of being obtained from wireless transmissions between the plurality mobile stations and a network of fixed location transceivers [base stations, wherein said base stations in the network are cooperatively linked for providing wireless communication with each of the mobile stations,] the improvement characterized by:

providing a mobile station location estimator for estimating locations of one or more individual mobile stations of said plurality of mobile stations when said location estimator is supplied with said [wireless] signal measurements obtained from wireless transmissions between the individual mobile station and said network of [base stations] transceivers;

storing a plurality of data item collections, wherein for each of a plurality of geographical locations, there is one of said data item collections having (a1) and (a2) following:

(a1) a representation of the geographical location, and

(a2) a representation of said [wireless] signal measurements between one of the mobile stations and the [base stations] transceivers when said one mobile station is approximately at the geographical location of (a1);

generating, from said [wireless] signal measurements between said mobile and said transceivers [base stations], an initial location estimate of said mobile;

obtaining a first set of one or more additional location estimates generated by said location estimator, wherein each said additional location estimate is generated [from] using said representations of [wireless] signal measurements of (a2) for one of said data item collections, and

wherein at least a majority of said additional location estimates satisfy a predetermined constraint dependent on [are within a predetermined distance of] said initial location estimate;

deriving [an adjusted] a further location estimate [from said initial location estimate] of said mobile station using a [second set] group of one or more of said geographical location representations of (a1) for said data item collections whose representations of [wireless] signal measurements of (a2) were used to generate one of said additional location estimates of said first set.

21. (Once Amended) A method as claimed in Claim 20, wherein said step of deriving includes determining an area boundary of said [adjusted] further location estimate as a function of said geographical locations in said [second set] group.

22. (Once Amended) A location system for locating a mobile station[s from received] using wireless signal measurements obtained from transmissions between said mobile station[s] and a network of fixed location transceivers [base stations], wherein said [base stations in the network] transceivers are cooperatively linked for use in locating the mobile stations [providing wireless communication], the improvement characterized by:

one or more location estimators for estimating locations of said mobile station[s, such that for each of said mobile stations,] when said location estimators are supplied with measurements of wireless signals obtained from transmissions between:

- (i) the mobile station, at a corresponding geographical location [from which the mobile station is transmitting], and
- (ii) said transceivers [network of base stations,]

[at least one location estimate is generated];

a location estimate adjuster for deriving [a first adjusted] an additional location estimate [from] of said mobile station using a first location estimate generated by a first of said location estimators [supplied with said wireless signal measurements obtained from transmissions between: (i) a particular one of said mobile stations, at a particular location, and (ii) said base stations], wherein:

(a1) said [first adjusted] additional location estimate has a corresponding confidence value indicative of a likelihood of the [particular] corresponding geographical location being a location represented by [the first adjusted] said additional location estimate, and

(a2) said [first adjusted] additional location estimate is determined using [additional] other location estimates generated: (i) previously to the generation of said [first initial] additional location estimate, and (ii) by said first location estimator;

a most likely estimator for determining a most likely location estimate of the [particular] corresponding geographical location of the [particular] mobile station, said most likely location estimate being derived using said [first adjusted] additional location estimate and its corresponding confidence value.

23. (Once Amended) A location system, as claimed in Claim 22, wherein[,] said location estimate adjuster includes a statistical simulation module for deriving [a] one or more likelihood values indicative of said first location estimator generating [mobile station] a location estimate[s] that includes the [their] corresponding geographical location[s].

24. (Once Amended) A location system, as claimed in Claim 22, wherein, said most likely estimator includes a probability density function for fuzzifying at least said confidence value for said [first adjusted] additional location estimate over an area adjacent a boundary [outside] of said [first adjusted] additional location estimate.

25. (Once Amended) A location system for locating mobile stations from received wireless signal measurements obtained from transmissions between said mobile stations and a network of fixed location transceivers, wherein said transceivers in the network are cooperatively linked for use in locating [providing wireless communication with] said mobile stations, the improvement characterized by:

an archive for storing a plurality of data item collections, wherein for each location of a plurality geographical locations, there is one of said data item collections having (a1) and (a2):

(a1) a representation of the geographical location,

(a2) a set of said wireless signal measurements obtained from transmissions between one of said mobile stations and said fixed location transceivers, wherein the one mobile station transmits from approximately the geographical location;

a plurality of trainable location estimators, each said trainable location estimator for generating [a] geographical location estimates for said mobile stations, wherein for each said trainable location estimator:

(b1) there is a corresponding group of wireless signal measurement parameters, wherein for said trainable location estimator to generate a location estimate of an individual one of said mobile stations, at least some of said parameters must be instantiated with values

obtained from transmissions between said individual mobile station and said fixed location transceivers, and

(b2) [there is a different corresponding group of wireless signal measurement parameters for another of said trainable location estimators, and

(b3)] said trainable location estimator learns by associating, for each of at least some of said data item collections, said geographical location representation (a1) of the data item collection with said set of said wireless signal measurements (a2) of the data item collection; a location estimator selector for selecting one or more of said plurality of trainable location estimators for generating mobile station location estimates, [wherein when each of said selected location estimators has its corresponding group of wireless signal measurement parameters instantiated with values obtained from transmissions between one of said mobile stations and said fixed location transceivers, said selected location estimator generates a location estimate of the one mobile station;]

wherein for locating a particular one of said mobile stations, said location estimator selector selects a particular set of one or more of said trainable location estimators [whose corresponding group of wireless signal measurement parameters can have] having at least [some] one of said parameters capable of being instantiated using wireless signal measurements obtained from transmissions between said particular mobile station and said fixed location transceivers;

a location estimator for determining a resulting location estimate of said particular mobile station, said location estimator receiving one or more location estimates from the trainable location estimators of said particular set.

26. (Once Amended) A location system, as claimed in Claim 25, wherein at least a first [one] of said trainable location estimators includes an artificial neural network.

27. (Once Amended) A [method] location system as claimed in Claim 25, further including a different second one of said trainable location estimators, wherein said second trainable location estimator utilizes [utilizing] a different artificial neural network for generating a [different] geographical location estimate [of] for one of said one mobile stations.

28. (Once Amended) A [method] location system as claimed in Claim 26, wherein said artificial neural network is one of: a multilayer perceptron, an adaptive resonance theory model, and radial basis function network.

29. (Once Amended) A [method] location system as claimed in Claim 25, wherein at least one said trainable location estimators utilizes an artificial neural network with an input neuron for receiving a value related to wireless transmissions between said particular mobile station and a particular one of said fixed location transceivers, wherein said value is indicative of at least one of the following conditions:

(a) said particular transceiver is active for wireless communication with said particular mobile station and a pilot signal by said particular transceiver is detected by said particular mobile station;

(b) said particular transceiver is active for wireless communication with said particular mobile station and said particular transceiver detects wireless transmissions by said particular mobile station;

(c) said particular transceiver is active for wireless communication with said particular mobile station and said particular transceiver does not detect wireless transmissions by said particular mobile station;

(d) said particular transceiver is active for wireless communication with said particular mobile station and said particular mobile station does not detect wireless transmissions by said particular transceiver;

(e) said particular transceiver is not active for wireless communication with said particular mobile station.

30. (Once Amended) A location system for receiving wireless signal measurements of wireless signals transmitted between a plurality of mobile stations and a network of [base stations] transceivers, wherein said [base stations in the network] transceivers are cooperatively linked for [providing wireless communication] use in locating the mobile stations, the improvement characterized by:

a plurality of mobile station location estimators for estimating locations of said mobile stations, such that when one or more of said location estimators are supplied with said measurements of wireless signals transmitted between one of the mobile stations and said network of [base stations] transceivers, said location estimators output [corresponding initial] first location estimates of a geographical location of said one mobile station, wherein for at least two of said mobile station

location estimators [of said plurality of mobile station location estimators] , each includes a different one of the following (a) through (f):

- as
cont
- (a) a pattern recognition component for estimating a location of said one mobile station from a pattern in the wireless signal measurements of transmissions between the network and said one mobile station;
 - (b) a trainable mobile station location estimating component for estimating a location of said one mobile station, wherein said trainable mobile station location estimating component is capable of being trained to associate: (i) each location of a plurality of geographical locations with (ii) corresponding measurements of wireless signals transmitted between a specified one of said mobile stations and the network, wherein said specified mobile station is approximately at the location;
 - (c) a triangulation component for estimating a location of said one mobile station, wherein said triangulation component utilizes said measurements of wireless signals between said one mobile station and three of the base stations for triangulating a location estimate of said one mobile station;
 - (d) a statistical component utilizing a statistical regression technique for estimating a location of said one mobile station;
 - (e) a mobile base station component for estimating a location of said one mobile station, wherein said mobile base station component utilizes location information received from a mobile base station that detects said one mobile station;
 - (f) a negative logic component for estimating an area of where said one mobile station is unlikely to be located; and

a most likely estimator for determining a most likely location estimate of said one mobile station, [said most likely location estimate being a function of said plurality of] when said most likely estimator receives one or more of said first location estimates.

31. (Once Amended) A location system, as claimed in Claim 30, wherein one or more of said mobile station location estimators are capable of being at least one of: added, replaced and deleted by Internet transmissions between a first portion of said location system and a site [remote from] of said location system remote from said first portion.

As cont
32. (Once Amended) A location system for receiving wireless signal measurements of wireless signals transmitted between a plurality mobile stations and a network of base stations, wherein said base stations in the network are cooperatively linked for [providing wireless communication] use in locating the mobile stations, the improvement characterized by:

a mobile station location providing means for estimating locations of said mobile stations, such that when said providing means is supplied with said measurements of wireless signals transmitted between a particular one of the mobile stations and said network of base stations, said providing means determines a first collection of one or more location estimates for said particular mobile station;

an expert system for activating expert system rules for one of: (a) modifying one of said location estimates of said first collection, and (b) obtaining additional location estimates of the particular [location] mobile station;

a most likely estimator for determining a most likely location estimate of the particular [location] mobile station, said most likely location estimate being a function of one or more location estimates provided by said expert system.

33. (Once Amended) A location system for locating a wireless mobile station[s] that communicates with a plurality of networked base stations, comprising:

a wireless transceiver means: (a) for at least detecting a direction of wireless signals transmitted from a wireless mobile station, and (b) for communicating with said networked base stations information related to a location of said wireless mobile station;

as cont a means for detecting whether a detected wireless signal from said mobile station has been one of: reflected and deflected;

a means for estimating a location of said mobile station by using wireless signals transmitted from said mobile station that are not detected by said means for detecting as one of: reflected and deflected; and

transport means for moving at least said wireless transceiver means when locating said wireless mobile station.

34. (Once Amended) A location system as claimed in Claim 33, wherein said means for detecting includes a means for comparing: (a) a distance of said mobile station from said [mobile] location system using a signal strength of said wireless signals from said mobile station, and (b) a distance of said mobile station from said [mobile] location system using a signal time delay measurement of wireless signal from said mobile station.

35. (Once Amended) A location system as claimed in Claim 33, further including one or more location estimators for estimating a location of said [mobile] location system, wherein [said] at least one of said location estimators uses wireless signals transmitted from one of: said networked base stations and a global positioning system.

36. (Once Amended) A location system as claimed in Claim 35, further including a dead reckoning means for estimating a change in a location of said [mobile] location system, wherein said deadreckoning means provides incremental updates to said one or more location estimates of said [mobile] location system output by said at least one location estimator.

37. (Once Amended) A method for locating a particular wireless mobile station using measurements of particular wireless signals, wherein at least one of: said measurements and said particular wireless signals are transmitted between [said] the particular wireless mobile station and at least one of a plurality of transceivers, wherein said transceivers are capable of at least wireless detection of a plurality of wireless transmitting mobile stations including said particular mobile station, comprising:

providing [a] first and second mobile station location estimators, wherein each of said location estimators is capable of providing a location estimate for each mobile station of at least some of said mobile stations when said location estimator is supplied with corresponding data obtained from received wireless signal measurements communicated between the mobile station and one or more of said plurality of transceivers, wherein:

- (a) said first location estimator performs one or more triangulation techniques, wherein [each said triangulation technique determines for each of one or more of said mobile stations, and] for each transceiver of a set of three or more of said transceivers, a distance between the mobile station, and said transceiver is determined, each said distance determined from data resulting from received measurements of wireless signals communicated between the mobile station and said transceiver, and
- (b) said second location estimator does not perform [any] one of said triangulation techniques;

first supplying said first location estimator with first corresponding data obtained from received wireless signal measurements communicated between said particular mobile station and one or more of said plurality of transceivers;

second supplying said second location estimator with second corresponding data obtained from received wireless signal measurements communicated between said particular mobile station and one or more of said plurality of transceivers;

first generating, by said first location estimator, first location related information having at least a first estimate for the particular mobile station's location;

second generating, by said second location estimator, second location related information having at least a second estimate for the particular mobile station's location;

determining a resulting location estimate of the particular mobile station using: (a) a first value obtained from said first location related information, and (b) a second value obtained from said second location related information.

38. (Once Amended) A method for locating a [particular] wireless mobile station [using measurements of particular wireless signals, wherein at least one of: said measurements and said particular wireless signals are transmitted between said wireless mobile station and at least one of a plurality of transceivers, wherein said transceivers are capable of at least wireless detection of a plurality of wireless transmitting mobile stations including said particular mobile station,] comprising:

providing [a] first and second mobile station location estimators, wherein each of said location estimators is capable of providing a location estimate for [each] said mobile station [of at least some of said mobile stations when said location estimator is supplied with corresponding data obtained from received wireless signal measurements communicated between the mobile station and one or more of said plurality of transceivers], wherein:

- (a) said first location estimator estimates said mobile station when supplied with first data wherein said first data includes values of wireless signals from one or more satellites; [performs one or more global positioning techniques, wherein each said global positioning technique determines for each of one or more of said mobile stations, corresponding data resulting from received measurements of wireless signals from one or more global positioning satellites, said corresponding data for determining a location of the mobile station,] and
- (b) said second location estimator estimates said mobile station when supplied with second data, wherein said second data includes measurements of wireless signals between said mobile station and at least one of said transceivers [does not perform any said global positioning technique];

first supplying said first location estimator with said first [corresponding] data [obtained from wireless signal measurements communicated between said particular mobile station and one or more of said plurality of transceivers];

second supplying said second location estimator with said second [corresponding] data [obtained from wireless signal measurements communicated between said particular mobile station and one or more of said plurality of transceivers];

first generating, by said first location estimator, first location related information having at least a first estimate for said [particular] mobile station's location;

As cont
second generating, by said second location estimator, second location related information having at least a second estimate for said [particular] mobile station's location;

determining a resulting location estimate of said [particular] mobile station using: (a) a first value obtained from said first location related information, and (b) a second value obtained from said second location related information.

39. (Once Amended) A method for locating a particular wireless mobile station using measurements of particular wireless signals, wherein at least one of: said measurements and said particular wireless signals are transmitted between said wireless mobile station and at least one of a plurality of fixed location transceivers, [wherein said transceivers are capable of at least wireless detection of a plurality of wireless transmitting mobile stations including said particular mobile station,] comprising:

providing a first and second mobile station location estimators, wherein each of said location estimators is capable of providing a location estimate for [each] said particular mobile station [of at

least some of said mobile stations when said location estimator is supplied with corresponding data obtained from received wireless signal measurements communicated between the mobile station and one or more of said plurality of transceivers], wherein:

as cont

(a) said first location estimator performs one or more coverage area analysis techniques when said first location estimator is supplied with first data obtained from received wireless signal measurements communicated between the particular mobile station and one or more of said plurality of transceivers, wherein each said coverage area analysis technique determines for [each of one or more of] said particular mobile station[s], at least one of: an area: (i) included in a corresponding coverage area for each of one or more of said transceivers that detect the particular mobile station, and [(ii)] an area excluded from a corresponding coverage area for each of one or more of said transceivers that can not detect the particular mobile station, and

(b) said second location estimator does not perform any said coverage area analysis technique when said second location estimator is supplied with second data obtained from received wireless signal measurements communicated between the particular mobile station and one or more of said plurality of transceivers;

first supplying said first location estimator with said first [corresponding] data [obtained from wireless signal measurements communicated between said particular mobile station and one or more of said plurality of transceivers];

second supplying said second location estimator with second [corresponding] data [obtained from wireless signal measurements communicated between said particular mobile station and one or more of said plurality of transceivers];

generating, by said first and a second of said location estimators, respectively, first and second different initial location estimates of said particular mobile station;

determining a location estimate of said particular mobile station as a function of at least one of: (a) said first and second initial location estimates, and (b) a rating of said first and second initial location estimates.

40. (Once Amended) A method for locating a wireless mobile station capable of wireless communication with a plurality of base stations, comprising:

providing a plurality of mobile station location estimators, wherein said location estimators provide different location estimates of said mobile station when said location estimators are supplied with location information derived from signal measurements that are transmitted between said mobile station and said plurality of base stations;

receiving measurements of wireless signals transmitted: (a) from one or more global positioning satellites, and (b) between said wireless mobile station and said plurality of base stations; first generating, by a first of said location estimators, a first time series of one or more location estimates of said mobile station when at least a portion of said measurements are obtained for global positioning satellite signals;

second generating[], by a second of said location estimators, a second time series of one or more location estimates of said mobile station when at least a portion of said measurements provide measurements of wireless signals transmitted between said mobile station and at least one of base stations of said plurality of base stations;

determining a resulting time series of one or more resulting location estimates of said mobile station, wherein for each time of said resulting time series when one of said resulting location estimates is derived, said derivation uses at least one location estimate: (a) that is most recently generated by said first location estimator, and (b) that is most recently generated by said second location estimator.

41. (Once Amended) A method as claimed in Claim 40, wherein said step of determining includes:

establishing a priority between [said first initial] location estimates of said first time series and said [second initial] location estimates of said second time series.

As cont

42. (Once Amended) A method as claimed in Claim 41, wherein said step of establishing includes obtaining a confidence value corresponding to one or more of: (a) at least one of said location estimates for said first [initial location estimate] time series; and (b) at least one of said location estimates for said second [initial location estimate] time series, wherein each said confidence value is indicative of a likelihood of said mobile station being its said corresponding [initial] location estimate.

43. (Once Amended) A method as claimed in Claim 41, wherein said step of establishing includes using a first time value associated with said [first initial] location estimates of said first time series, and a second time value associated with said [second initial] location estimates of said second time series.

44. (Once Amended) A method as claimed in Claim 40, wherein said step of determining includes preferring a [said] first [initial] location estimate of said first time series over a [said] second [initial] location estimate of said second time series when both are available for substantially a same location of said mobile station.

45. (Once Amended) A method as claimed in Claim 40, wherein said step of receiving includes receiving a first portion of said measurements in a first time period and a second portion of said measurements in a second time period different from said first time period, wherein said first portion is obtained from [a] the one or more global positioning satellites, and said second portion is derived from wireless signals transmitted between said mobile station and at least one [of] base station of said first plurality of base stations.

47. (Once Amended) A method as claimed in Claim 40, wherein said step of determining includes evaluating one or more constraints related to one or more of: a velocity of said mobile station, an acceleration of said mobile station, an estimated location of said mobile station in relation [of] to a terrain of said estimated location.

Please add the following new Claims 48-84.

48. (New) A method for providing a location estimate of a wireless mobile station using measurements of wireless signals, comprising:

first receiving, when available, a first collection of measurements of wireless signals transmitted between said mobile station and one or more satellites;

second receiving a second collection of measurements of wireless signals transmitted between said mobile station and one or more terrestrial base stations, at least when said first collection is not available;

first determining a first location estimate of said mobile station using said first measurements when said first collection is available;

second determining a second location estimate of said mobile station using said second measurements when said second collection is available;

outputting a resulting location estimate obtained using at least one of said first and second location estimates.

49. (New) A method as claimed in Claim 48, wherein said steps of Claim 48 are performed for a single emergency response request.

50. (New) A method as claimed in Claim 49, further including a step of outputting, to an emergency response center, said resulting location estimate of said mobile station in response to said emergency response request.

51. (New) A method for locating a mobile station using wireless signal measurements obtained from transmissions between said mobile station and a plurality of fixed location communication stations, wherein each of said communications stations includes one or more of a transmitter and a receiver for wirelessly communicating with said mobile station, comprising:

providing first and second mobile station location evaluators, wherein said location evaluators determine information related to one or more location estimates of said mobile station when said location estimators are supplied with data having values obtained from wireless signal measurements obtained via transmissions between said mobile station and the communication stations, wherein:

(A) said first location evaluator performs one or more of the following techniques (i), (ii) and (iii) when supplied with a corresponding instance of said data:

(i) a first technique for determining, for at least one of the communication stations, one of: a distance, a wireless signal angle of arrival, and a time difference of arrival between the mobile station and the communication station;

(ii) a second technique for estimating a location of said mobile station, using values from a corresponding instance of said data obtained from signals received by the mobile station from one or more satellites;

(iii) a third technique for recognizing a pattern of characteristics of a corresponding instance of said data, wherein said pattern of characteristics is indicative of a plurality of wireless signal transmission paths between the mobile station and each of one or more of the communication stations; and

(B) for at least a particular one of said techniques performed by said first location estimator, said second location evaluator performs a different one of said techniques when supplied with a corresponding instance of said data for the different technique;

first generating, by said first location estimator, first location related information using an available first corresponding instance of said data;

second generating, by said second location evaluator, second location related information using an available second corresponding instance of said data;

determining a resulting location estimate of the mobile station dependent upon at least one of: (a) a first value obtained from said first location related information, and (b) a second value obtained from said second location related information.

52. The method as claimed in Claim 51, wherein one or more of said mobile station location evaluators generates a location estimate of said mobile station.

53. The method as claimed in Claim 51, wherein said mobile station is co-located with a processor for activating at least one of said location estimators.

54. (New) A method for locating a mobile station using wireless signal measurements obtained from transmissions between said mobile station and a plurality of fixed location communication stations, wherein each of said communications stations includes one or more of a transmitter and a receiver for wirelessly communicating with said mobile station, comprising:

providing first and second mobile station location evaluators, wherein said location evaluators determine information related to one or more location estimates of said mobile station when said location estimators are supplied with data having values obtained using wireless signals obtained via transmissions between said mobile station and the communication stations, wherein:

(A) said first location evaluator performs one or more of the following techniques (i), (ii) and (iii) when supplied with a corresponding instance of said data:

(i) a first technique to determine a wireless signal angle of arrival between the mobile station and at least one of the communication stations;

(ii) a second technique for estimating a location of said mobile station using values from a corresponding instance of said data obtained from signals received by the mobile station from one or more satellites;

(iii) a third technique, wherein said third technique uses a statistical correlation for correlating (a) and (b) following:

(a) wireless signal related values of a corresponding instance of said data instance;

(b) information indicative of a location for the mobile station, wherein said correlation is used for determining a probability that the mobile station is within at least one area, and

(B) for at least a particular one of said techniques performed by said first location estimator, said second location estimator performs a different one of said techniques when supplied with a corresponding instance of data for the different technique;

first generating, by said first location estimator, first location related information of the mobile station's location using an available first corresponding instance of said data;

second generating, by said second location estimator, second location related information of the mobile station's location using an available second corresponding instance of said data;

wherein each of said first and second location related information is capable of being generated independently of the other of said first and second location related information;

determining a resulting location estimate of the mobile station using at least one of: (a) a first value obtained from said first location related information, and (b) a second value obtained from said second location related information.

55. (New) A method for locating a mobile station using wireless signal measurements obtained from transmissions between said mobile station and a plurality of fixed location communication stations, wherein each of said communications stations includes one or more of a transmitter and a receiver for wirelessly communicating with said mobile station, comprising:

providing first and second mobile station location evaluators, wherein said location evaluators determine information related to one or more location estimates of said mobile station when said location estimators are supplied with data having values obtained from wireless signal measurements obtained via transmissions between said mobile station and the communication stations, wherein:

(A) said first location evaluator performs one or more of the following techniques (i), (ii), (iii) and (iv) when supplied with a corresponding instance of said data:

(i) a first technique for determining, for at least one of the communication stations, one of: a distance, a time of arrival of wireless signals, and a time difference of arrival of wireless signals between the mobile station and the communication station;

(ii) a second technique for determining, for at least one of the communication stations, a wireless signal angle of arrival between the mobile station and the communication station;

(iii) a third technique for estimating a location of said mobile station, using values from a corresponding instance of said data obtained from signals received by the mobile station from one or more satellites;

(iv) a fourth technique, wherein said fourth technique provides an association for associating, for each of a plurality of mobile station locations, multipath wireless signal characteristics between: (a) one or more of the communication stations, and (b) a mobile station at the location;

Ho
cont
(B) for at least a particular one of said techniques performed by said first location estimator, said second location evaluator performs a different one of said techniques when supplied with a corresponding instance of said data for the different technique;

first generating, by said first location estimator, first location related information using an available first corresponding instance of said data;

second generating, by said second location evaluator, second location related information using an available second corresponding instance of said data;

determining a resulting location estimate of the mobile station dependent upon at least one of: (a) a first value obtained from said first location related information, and (b) a second value obtained from said second location related information.

56. (New) A method for locating a mobile station using wireless signal measurements obtained from transmissions between said mobile station and a plurality of fixed location communication stations, wherein each of said communications stations includes one or more of a transmitter and a receiver for wirelessly communicating with said mobile station, comprising:

providing first and second mobile station location evaluators, wherein said location evaluators determine information related to one or more location estimates of said mobile station when said location estimators are supplied with data having values obtained from wireless signal measurements obtained via transmissions between said mobile station and the communication stations, wherein:

(A) said first location evaluator performs one or more of the following techniques (i), (ii), (iii) and (iv) when supplied with a corresponding instance of said data:

(i) a first technique for determining, for at least one of the communication stations, one of: a distance, a wireless signal angle of arrival, and a time difference of arrival between the mobile station and the communication station;

(ii) a second technique for estimating a location of said mobile station, using values from a corresponding instance of said data obtained from signals received by the mobile station from one or more satellites;

(iii) a third technique, wherein said third technique provides an association for associating, for each of a plurality of mobile station locations, multipath wireless signal characteristics between: (a) one or more of the communication stations, and (b) a mobile station at the location; and

(iv) a fourth technique, wherein said fourth technique uses a statistical correlation for correlating (a) and (b) following:

(a) wireless signal related values obtained from a corresponding instance of said data, and

(b) information indicative of a location for the mobile station, wherein said correlation is used for determining a probability that the mobile station is within a corresponding geographical area, and

(B) for at least a particular one of said techniques performed by said first location estimator, said second location evaluator performs a different one of said techniques when supplied with a corresponding instance of said data for the different technique;

first generating, by said first location estimator, first location related information using a supplied first corresponding instance of said data;

second generating, by said second location evaluator, second location related information using a supplied second corresponding instance of said data;

wherein each of said first and second location related information is capable of being generated substantially independently of the other of said first and second location related information;

determining a resulting location estimate of the mobile station dependent upon at least one of: (a) a first value obtained from said first location related information, and (b) a second value obtained from said second location related information.

57. (New) A method for locating a mobile station using wireless signal measurements obtained from transmissions between said mobile station and a plurality of fixed location communication stations, wherein each of said communications stations includes one or more of a transmitter and a receiver for wirelessly communicating with said mobile station, comprising:

providing first and second mobile station location evaluators, wherein said location evaluators determine information related to one or more location estimates of said mobile station when said location estimators are supplied with data having values obtained from wireless signal measurements obtained via transmissions between said mobile station and the communication stations, wherein:

(A) said first location evaluator performs one or more of the following techniques (i), (ii) and (iii) when supplied with a corresponding instance of said data:

(i) a first technique for estimating a location of said mobile station, using values from a corresponding instance of said data obtained from signals received by the mobile station from one or more satellites;

(ii) a second technique for recognizing a pattern of characteristics of a corresponding instance of said data, wherein said second technique uses an association for associating, for each of a plurality of mobile station locations, multipath wireless signal characteristics between: (a) one or more of the communication stations, and (b) a mobile station at the location; and

(iii) a third technique, wherein said third technique uses a statistical correlation for correlating (a) and (b) following:

(a) wireless signal related values of a corresponding instance of said data for the third technique, and

(b) information indicative of a location for the mobile station, wherein said correlation is used for determining a probability that the mobile stations is within a corresponding geographic area, and

(B) for at least a particular one of said techniques performed by said first location estimator, said second location evaluator performs a different one of said techniques when supplied with a corresponding instance of said data for the different technique;

first generating, by said first location estimator, first location related information using a supplied first corresponding instance of said data;

second generating, by said second location evaluator, second location related information using a supplied second corresponding instance of said data;

determining a resulting location estimate of the mobile station dependent upon at least one of: (a) a first value obtained from said first location related information, and (b) a second value obtained from said second location related information.

58. (New) A method for locating a wireless mobile station using wireless signal measurements obtained from transmissions between said mobile station and a plurality of communication stations capable of wirelessly detecting said mobile station, comprising:

first determining whether a first location estimate of said mobile station is capable of being determined by a particular one of:

(a) a first technique for determining, for at least one of the communication stations, one of: a distance, a wireless signal angle of arrival, and a time difference of arrival between the mobile station and the communication station using the wireless signal measurements;

(b) a second technique using measurements from signals received by the mobile station from one or more satellites;

- (c) a pattern recognition location technique for estimating a location of said mobile station by recognizing a pattern of characteristics of data obtained from wireless signal measurements, wherein said pattern of characteristics is indicative of multipath wireless signal transmissions paths between the mobile station and one or more of the communication stations;

second determining a second location estimate of said mobile station by a different one of said techniques when one of: (i) said step of first determining determines that said particular technique is unable to provide said first location estimate, and (ii) said second location estimate is expected to be more accurate or reliable than said first location estimate.

59. (New) A method for locating a mobile station using wireless signal measurements obtained from transmissions between said mobile station and at least one of a plurality of terrestrial communication stations capable of wirelessly detecting said mobile station, comprising:

providing two or more of the location techniques (a) through (c) following:

- (a) a first technique for triangulating, wherein for each of three or more of the communication stations, one of: a distance, a signal time of arrival, and a signal time difference of arrival between the mobile station and the communication station is determined using a first input obtained from the wireless signal measurements;
- (b) a second technique using a second input obtained from one or more transmissions between the mobile station and the communication stations, said second input including measurements of signals received by the mobile station from one or more satellites;

(c) a third technique that learns an association between a plurality of pairs of (i) and (ii) following:

(i) characteristics of wireless signals communicated between some mobile station and one or more of the communication stations, and

(ii) a location of said some mobile station during the communication,

wherein said association is determined by a training process using a plurality of said pairs, wherein when said third technique is supplied with a third input of characteristics of wireless signals communicated between said mobile station and one or more of the communication stations, data indicative of a location of the mobile station is obtained;

determining whether a particular one of the location techniques (a) through (c) has its corresponding input available for determining a first location estimate of said mobile station;

determining a second location estimate of said mobile station by activating one of said location techniques different from said particular location technique when the corresponding input for said different technique is available.

60. (New) The method as claimed in Claim 59, wherein at least two of said location techniques generate location estimates of said mobile station that do not depend upon one another for their corresponding input to be available.

61. (New) A method for locating a mobile station using wireless signal measurements obtained from transmissions between said mobile station and at least one of a plurality of communication stations capable of wirelessly detecting said mobile station, comprising:

providing two or more of the location techniques (a) through (e) following:

(a) a triangulation technique for determining, for each of three or more of the communication stations, one of: a distance, a wireless signal time of arrival, and a wireless signal time difference of arrival between the mobile station and the communication station using a first input obtained from the wireless signal measurements;

(b) a stochastic technique, wherein said stochastic technique uses a statistical correlation for correlating:

(i) a second input obtained from the wireless signal measurements, and

(ii) data indicative of a location area for the mobile station,

wherein a probability that the mobile station is within the correlated location area is capable of being determined from said correlation;

(c) a learning technique, for learning an association wherein said association is determined by a training process using a plurality of data pairs, each said pair including: first information indicative of a location of some mobile station, and second information from wireless signal measurements between said some mobile station and one or more of the communication stations when said some mobile station is at the location;

wherein when said learning technique is supplied with a third input obtained from the wireless signal measurements, data indicative of a location for the mobile station is determined;

(d) a pattern recognition location technique for estimating a location of said mobile station by recognizing a pattern of characteristics of a fourth input obtained from the wireless signal measurements, wherein said pattern of characteristics is indicative of multipath wireless signal transmissions between the mobile station and one or more of the communication stations;

(e) a location technique using a fifth input obtained from measurements from signals received by the mobile station from one or more satellites;

determining whether a particular one of the location techniques (a) through (e) has its corresponding input available for determining a first location estimate of said mobile station;

determining a second location estimate of said mobile station by activating one of said location techniques different from said particular location technique when the corresponding input for said different technique is available, and said corresponding input to said particular location technique is unavailable.

62. (New) The method as claimed in Claim 61, wherein
said first, second, third, and fourth inputs include data related to one or more of: a wireless signal time delay, a wireless signal strength, and a power level of the mobile station; and
said fifth input includes data related to GPS satellite signals.

63. (New) A method for locating one or more wireless mobile stations using wireless signal measurements obtained from transmissions between said mobile stations and a plurality of communication stations capable of at least one of: wirelessly detecting said mobile stations, and being wirelessly detected by said mobile stations, comprising:

archiving a plurality of data item collections, wherein each said data item collection includes (a1) and (a2):

(a1) a representation of a location of one of said mobile stations,

(a2) a set of measurements of said wireless signal data obtained from transmissions between one of said mobile stations and at least one of said communication stations, wherein said one mobile station transmits from approximately the corresponding location represented in (a1), and wherein said set of measurements include one or more of (i) and (ii) following:

(i) a signal strength measurement corresponding to a transmission between said one mobile station and one of said communication stations;

(ii) a signal time delay measurement corresponding to a transmission between said one mobile station and one of said communication stations;

providing a plurality of pattern matching location estimators, wherein at least one of said location estimators uses at least one association between (a1) and (a2) of the archived data item collections when locating one of said mobile stations;

receiving wireless signal data obtained from transmissions between said communication stations and a particular one of said mobile stations at an unknown location, wherein said wireless signal data includes one or more measurements for said set of measurements;

selecting, using a value dependent upon said wireless signal data, one or more of said location estimators;

determining one or more location estimates of said particular mobile station when said selected location estimators are provided with input obtained using said wireless signal data.

64. (New) The method as claimed in Claim 63, wherein, said step of selecting includes using a value indicative of an identification of at least one of said communication stations.

65. (New) The method as claimed in Claim 63, wherein said wireless signal data includes information indicative of one of: said particular mobile station being detected by at least one of said communication stations, and said particular mobile station detecting at least one of said communication stations.

66. (New) The method as claimed in Claim 63, wherein said set of measurements further includes one or more of:

a value indicative of a make of said particular mobile station; and

a value indicative of a model of said particular mobile station.

67. (New) The method as claimed in Claim 63, wherein said set of measurements further includes one or more of:

a measurement indicative of a current transmission power of said particular mobile station;

a measurement indicative of a maximum transmission power of said particular mobile station;

a measurement indicative of a transmission power level of one of said communication stations;
one or more values indicative of which of said communication stations is on-line and thereby
capable of wireless communication with said particular mobile station;

one or more values indicative of which of said communication stations detects a wireless
transmission from said particular mobile station;

one or more values indicative of which of said communication stations is detected by said
particular mobile station.

90 sent
68. (New) The method as claimed in Claim 63, wherein one or more of said adaptive
location estimators includes one of: an artificial neural network, a genetic algorithm, a statistically
based pattern recognition system, and an expert system.

69. (New) The method as claimed in Claim 68, wherein said statistically based pattern
recognition system includes a regression analysis procedure.

70. (New) The method as claimed in Claim 63, wherein said step of selecting includes
evaluating an expert system rule.

71. (New) A location system for locating one or more wireless mobile stations using
wireless signal measurements obtained from transmissions between said mobile stations and a plurality

of communication stations capable of at least one of: wirelessly detecting said mobile stations, and being wirelessly detected by said mobile stations, comprising:

an archive for storing a plurality of data item collections, wherein each said data item collection includes (a1) and (a2) following:

(a1) a representation of a location of one of said mobile stations,

(a2) data indicative of said wireless signal transmissions between said one mobile station and at least one of said communication stations, wherein said one mobile station transmits from approximately the mobile station location;

800
cont

a plurality of location estimators, each of at least some of said location estimators accesses information indicative of at least one association between (a1) and (a2) for a plurality of said data item collections for determining a location estimate of an unknown location of a particular one of said mobile stations, wherein said location estimator uses a corresponding data set indicative of wireless signal transmissions between said particular mobile station at said unknown location, and one or more of said communication stations;

a location estimator selector for selecting one or more of said plurality of location estimators for determining one or more location estimates of said particular mobile station, said selector selects each said location estimator by using information indicative of identifications that identify one or more communication devices, wherein each said communication device: (i) is one of a wireless signal transmitter and a wireless signal receiver located at one of said communication stations, and (ii) communicates with said particular mobile station thereby providing at least a portion of said corresponding data set used by said location estimator.

72. (New) The location system as claimed in Claim 71, wherein, when said selector selects one of said location estimators that activates an artificial neural network.

73. (New) The location system as claimed in Claim 71, wherein at least one of said communication stations is included in a satellite.

74. (New) The location system as claimed in Claim 71, wherein one of said location estimators includes one of:

a pattern recognition capability for estimating a location of said particular mobile station; and
a statistical correlation technique for estimating a location of said particular mobile station;
wherein said one location estimator uses a derived relationship between said sets of wireless signal measurements of said archived data item collections for predicting a location of said particular mobile station.

75. (New) The location system as claimed in Claim 74, wherein one of:
said statistical correlation technique uses one of: principle decomposition, least squares, partial least squares, and Bollenger Bands; and
said pattern recognition capability uses an artificial neural network.

76. (New) The location system as claimed in Claim 75, wherein said artificial neural network includes one of: a multilayer perceptron, an adaptive resonance theory model, and a radial basis function network.

77. (New) The location system as claimed in Claim 71, wherein for selecting at least one of said location estimators, said identifications identify a predetermined plurality of wireless terrestrial fixed location wireless communication devices, and said corresponding data set for the location estimator includes information indicative of one or more of:

whether one of said communication devices is on-line,

whether one of said communication devices detects a wireless transmission from said particular mobile station,

whether said particular mobile station detects transmissions from one of said communication devices.

78. (New) A method for locating one or more wireless mobile stations using wireless signal measurements obtained from transmissions between said mobile stations and a plurality of communication stations capable of at least one of: wirelessly detecting said mobile stations, and being wirelessly detected by said mobile stations, comprising:

storing a plurality of data collections, wherein each said data item collection includes (a1) and (a2) following:

(a1) a representation of a location of one of said mobile stations,

(a2) data indicative of said wireless signal transmissions between said one mobile station and at least one of said communication stations, wherein said one mobile station transmits from approximately the location represented in (a1);

determining a collection of parameters of a wireless mobile station location system that affect a performance of said wireless mobile station location system in locating said mobile stations;

determining, for said collection of parameters, a plurality of data representations for values of said collection of parameters;

providing, to an adaptation component, one or more of said data representations, wherein for each of said data representations, said adaptation component determines a corresponding performance of said location system in locating said mobile stations by using said data representation and said plurality of data collections;

selecting a particular one of said data representations using said corresponding performances;

using said particular representation as an instance of said collection of parameters for deriving a location estimate of a first one said mobile stations, wherein a location of said first mobile station is unknown.

79. (New) The method as claimed in Claim 78, wherein said adaptation component includes an embodiment of a genetic algorithm.

80. (New) A method for locating a mobile station using wireless signal data obtained from transmissions between said mobile station and a plurality of communication stations capable of at least one of: wirelessly detecting said mobile station, and wirelessly being detected by said mobile station, comprising:

receiving said wireless signal data obtained from transmissions between said communication stations and said mobile station at an unknown location, wherein said wireless signal data includes at least two of:

(A1) measurements from wireless signal transmissions between said mobile station and three or more of said communication stations at terrestrial locations, wherein said measurements are capable of being used for providing a location estimate of said mobile station using one of triangulation and trilateration;

(A2) measurements from wireless signal transmissions from one or more satellites, each having one of the communication stations;

(A3) signal pattern measurements of wireless signal transmissions between said mobile station and one or more of said communication stations, wherein said signal pattern measurements are indicative of a multipath signal pattern at the unknown location between the mobile station and the communication stations;

generating one or more location estimates of said mobile station, using said wireless signal data, and at least two of the following location techniques:

(B1) a triangulation technique using the measurements from (A1);

(B2) a trilateration technique using the measurements from (A1);

(B3) a triangulation technique using the measurements from (A2);

(B4) a pattern recognition technique for estimating a location of said mobile station by recognizing a pattern of characteristics of said data obtained from wireless signal measurements wherein said pattern of characteristics is indicative of one or more wireless signal transmission paths between the mobile station and one or more of the communication stations.

81. (New) The method as claimed in Claim 80, wherein said step of generating includes performing a stochastic technique for generating a location estimate of said mobile station, wherein said stochastic technique uses a statistical correlation for correlating:

- (i) measurements from said wireless signal data, and
- (ii) previously obtained wireless signal data indicative of a plurality of known mobile station locations,

wherein said stochastic technique determines a probability that said unknown location is within a geographic area associated with the probability.

82. (New) The method as claimed in Claim 80, wherein said step of receiving includes one or more of:

receiving a value indicative of at least one of: a signal time delay signal, and a signal strength; and
receiving a value dependent upon a signal from a global positioning satellite.

83. (New) The method as claimed in Claim 80, wherein said step of generating includes providing at least one of said signal pattern measurements to a pattern recognizer that is trainable when repeatedly provided with previously obtained wireless signal data indicative of a plurality of known mobile station locations.

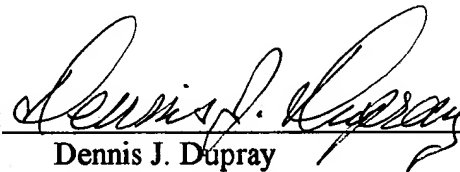
84. (New) The method as claimed in Claim 83, wherein said pattern recognizer includes one of: an artificial neural network and a genetic algorithm.

A check in the amount of \$840.00 is enclosed as payment of the fees for the addition of 13 independent claims and 37 total claims.

Applicants respectfully submit that the claims are in condition for allowance and request the Examiner's favorable consideration and passage to issuance thereof.

Respectfully submitted,

By:



Dennis J. Dupray
222 South Marion Parkway
Denver, Colorado 80209
(303) 778-1425

Date:

Feb. 25, 1999